

Automated Ordnance Excavator

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Robotics Group

THE CHALLENGE

There are over 20 million acres of test and target ranges under DOD control. Most of this acreage is contaminated with buried unexploded ordnance (UXO), including bombs, mines, submunitions, missiles, and rockets. With the continued downsizing of the military, millions of acres will be returned to the civilian sector for commercial and private use. This transition cannot occur until the land is completely cleared of all UXO contaminants.

The AFRL/MLQC Construction Automation Laboratory, located at Tyndall Air Force Base (AFB), Florida, under the sponsorship of the Army Environmental Center (AEC) and the direction of the Naval Explosive Ordnance Disposal Technology Division, is developing platforms/technologies to support a wide variety of missions. The Automated Ordnance Excavator (AOE) is a working example (Figure 1).



Figure 1. Automated Ordnance Excavator (AOE)

THE SOLUTION

The main component of the AOE is a Caterpillar 325L excavator with an extended reach option (Figure 2). With the extension arm, the AOE can reach to 60.5 feet and dig to a depth of 48.5 feet. This enables the AOE to retrieve buried ordnance while maintaining the furthest distance possible.

The AOE has a Vectran-teleoperated remote control system installed for radio frequency (RF) operations. This system can manipulate the functions normally performed by an on-board operator including boom, stick, bucket, swing, and driving control via radio link. An auxiliary mechanical thumb is installed at the bucket for grasping the UXO. Several cameras are installed to provide the remote operator the necessary video feedback for safe and effective control of the ex-

cavator. The operator performing the remote control tasks resides in a mobile command station that can operate the AOE up to 2 miles away via radio-frequency control.

A computer-generated map displaying the entire work area depicts topographical features, potential target locations, and the position of the excavator in a "real-time" situation. Given latitude/longitude coordinates of the UXO, the AOE utilizes a differential global positioning system (GPS) satellite input to travel directly to the hazard and locate a target within centimeters. Once at the excavation site, the remote operator digs via video feedback to the AOE to uncover and remove the ordnance.



Figure 2. Caterpillar 325L Excavator with Extended Reach Option

PAYOFF

The AOE has been used in numerous high human risk operations to recover test ordnance and in BRAC site closure actions. The system is robust, has low user maintenance, and is capable of all weather and varied terrain operations. The ability to perform excavation via remote control and autonomous operation, over a UXO field, will reduce exposure of Explosive Ordnance Disposal (EOD) personnel to the hazardous environment of the impact/bombing ranges. Remote operation provides the capability to remove the operator from the cab and associated hazardous conditions while providing a "bird's-eye" view of the digging area.

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